The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 29

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte DAVID J. TIGHE
and
ANDREW D. WILLIAMS

MAILED
MAR 10 2005
U.S. PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

Appeal No. 2005-0113
Application No. 09/582,760

HEARD: February 23, 2005

Before COHEN, NASE, and BAHR, Administrative Patent Judges.

NASE, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1 to 10, which are all of the claims pending in this application.

We AFFIRM-IN-PART.

BACKGROUND

The appellants' invention relates to fatigue alleviation in aircraft during all phases of the ground-air-ground cycle (specification, p. 1). A copy of the claims under appeal is set forth in the appendix to the appellants' brief.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Makhonine	2,585,480	Feb. 12, 1952
Bell	5,321,945	June 21, 1994

Claims 1 to 10 stand rejected under 35 U.S.C. § 103 as being unpatentable over Makhonine in view of Bell.

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellants regarding the above-noted rejection, we make reference to the answer (mailed August 12, 2002) for the examiner's complete reasoning in support of the rejections, and to the brief (filed June 3, 2002), reply brief (filed October 15, 2002), supplemental reply brief (filed January 31, 2003) and further supplemental reply brief (filed June 10, 2003) for the appellants' arguments thereagainst.

OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellants' specification and claims, to the applied prior art references, and to the respective positions articulated by the appellants and the examiner. As a consequence of our review, we make the determinations which follow.

The test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art. See In re Young, 927 F.2d 588, 591, 18 USPQ2d 1089, 1091 (Fed. Cir. 1991) and In re Keller, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). Moreover, in evaluating such references it is proper to take into account not only the specific teachings of the references but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. In re Preda, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

With this as background, we analyze the prior art applied by the examiner in the rejection of the claims on appeal.

Makhonine's invention is directed to a device for changing the loading of aircraft wings. In the embodiment illustrated in Figure 2 of Makhonine, each wing a is provided with an inner reservoir f, located in front of the landing gear e, and an outer

reservoir g located adjacent to the marginal end of the wing. The reservoirs in each wing are connected through pipes h and i in which are inserted pumps j and k. Makhonine teaches (column 2, lines 8-15) that:

> After taking off, the pumps j pump fuel out of the reservoirs f and transfer it through the pipes h into the reservoirs g that were empty during the running of the aircraft over ground. Conversely the liquid contained inside the reservoirs g is again transferred into the reservoirs f through the pumps k and the pipes i when landing.

Bell's invention relates to a method of controlling fluid transfers, and more particularly, to a method for controlling fuel transfers from the fuel tanks of a distributed fuel tank system as normally found aboard an aircraft. Bell teaches (column 1, line 46, to column 2, line 30) that:

> In a situation in which one fuel tank has too much fuel and another tank has too little fuel, it is desired that fuel from the one tank be transferred to the second tank such that the tanks are in balance. This situation could occur when the aircraft engines are operating or when the aircraft engines are shut down. If the situation were to occur while the engines are operating, the transfer occurs while fuel flow is maintained to the engines. Fuel tank balance is desired for a number of reasons. Maintaining the balance minimizes the stress applied to the aircraft structure. Keeping the tanks in balance assists in controlling the aircraft center of gravity, which in turn determines how efficiently the aircraft flies with the corresponding cost savings.
>
> Present day solutions to the above identified problem are handled simply by including an additional crew member, a second officer (also known as the flight engineer), working in the cockpit to monitor the fuel system via various indicator lights and gages. At the flight engineer work station, all the switches, meters, . . . are available to permit the flight engineer to turn on/off the pumps, valves, . . . and allows the monitoring of the flow, pressures, quantities of the fuel

> in the system. Based on the current operating conditions, the flight engineer's knowledge of the system, and established operating procedures, the flight engineer recognizes certain conditions, e.g., the fuel tanks are out of balance. The flight engineer determines which pumps need to be turned on, which valves need to be opened, . . . in order to correct the condition. When the quantities in the tanks reach the levels desired by the flight engineer, the pumps and valves are shut down. The fuel tanks are now balanced as desired by the flight engineer. This present day system is oriented towards a human flight engineer who has detailed knowledge of the system, and extensive training and experience on how to operate the system. The flight engineer is intuitively aware of the aircraft flight regime, and is capable of interpreting all instructions from the other flight crew members or radio communications, is capable of reading and interpreting the aircraft log book, and seeks additional information and guidance from the flight crew, maintenance personnel, aircraft dispatcher, radio communications, and operating manuals when deemed necessary, and is capable of making subjective evaluations from other information available.
>
> In order to reduce aircraft operating costs, it is desired that the crew be reduced by eliminating the flight engineer. Thus there is a need to have an automated system which performs as closely as possible the functions of the flight engineer in an automated fuel distribution system predictably, reliably, and consistently.

Bell's invention provides a method of controlling fuel transfers from each of the tanks of a distributed fuel tank system. Bell's invention relates to a distributed fuel system, wherein a plurality of fuel tanks used for storing fuel are distributed in different locations. The fuel tanks are connected to each other via a manifold which permits fuel to flow therein. The distributed fuel system includes a plurality of control components interposed at predetermined points of the manifold to permit or restrict the flow of the fuel contained in the manifold in response to control signals. A method for distributing

the fuel between the fuel tanks to achieve predetermined levels in each of the fuel tanks comprises the steps of determining the status and condition of the fuel system. The function to be performed is then selected. Based on the system status and the function to be performed, the configuration of the control elements is selected to perform the function to be performed. The control signals are outputted to the control components to obtain the desired configuration of the control components for causing the fuel flow within the distributed fuel system to accomplish the desired function, thereby yielding the desired fuel distribution.

Bell further teaches (column 3, line 22, to column 4, line 59) that:

> Referring to FIG. 1, there is shown a layout diagram of the components which make up the fuel distribution system 1 of the preferred embodiment of the present invention. The preferred embodiment of the present inventions is for an aircraft having three (3) engines, engine 1 10, engine 2 20, and engine 3 30. An auxiliary power unit (APU) 21 is also included, to provide electrical power and air conditioning when the aircraft is on the ground. Six (6) fuel tanks (or more simply tanks), tank 1 100, tank 2 200, tank 3 300, upper auxiliary tank (Upper Aux Tank) 400, lower auxiliary tank (Lower Aux Tank) 500, and tail tank 600, are included in the aircraft for which the preferred embodiment of the present invention is described. Manifolds 700-703 are used to connect the tanks 100-600 to the engines 10-30. Fuel pumps (or more simply pumps), P, which supply pressurized fuel from a tank to a fuel manifold, are distributed throughout the fuel distribution system 1 as shown. Similarly, fill valves, F, and manifold valves, V, are distributed throughout the fuel distribution system 1 as shown in FIG. 1. Pumps, P, when turned on supply pressurized fuel from a tank to a manifold, and fill valves, F, when opened permit pressurized fuel from a manifold to flow into the tank. Manifold valves, V, control the flow of pressurized fuel from one manifold to another. Thus, manifold valves, V, permit fuel to flow in either direction when opened. The arrows in proximity with the pumps or valves in FIG. 1 are indicative

of the direction of the fuel flow, the pumps and valves sometimes referred to herein collectively as control components, or more simply as components. The control components are two (2) state devices, i.e. the pumps are either on or off, and the valves are either opened or closed (not including the transient conditions). As is well known to those skilled in the aircraft arts, the tanks 100-600 are distributed throughout the aircraft, i.e., in the wings, fuselage, tail, ...

If tail tank 600 is essentially empty, and while in flight, it is desired to adjust the center of gravity of the aircraft to achieve a more efficient flying posture, fuel from the more forward tank(s) is to be transferred to the tail tank. In order to effectuate this transfer (assuming tank 1 100 and tank 3 300 are very full and are to be emptied), then the configuration of the system is as described. Pumps 101, 102 are on to deliver fuel to engine 1 10, and manifold valve 120 is closed such that there is no interference with fuel flow to engine 1 10. Similarly, pumps 301, 302 are on to deliver fuel to engine 3 30, and manifold valve 32 is closed such that there is no interference with the fuel flow from tank 3 300 to engine 3 30. (Pumps 203, 204 are on to deliver fuel to engine 2 20, and manifold valve 220 is closed such that there is no interference with the fuel flow to engine 2 20. APU 21 may or may not be operative and pump 201 may or may not be on depending upon the volume of fuel required by APU 21 and engine 2 20. Let's assume APU 21, and pumps 201, 202 are off.) Since fuel is not to be transferred from tank 2 200, pump 205 is off. Conversely, since fuel is to be transferred from tank 1 100 and tank 3 300, pumps 103 and 303 are on. Fuel then flows from tank 1 100 and tank 3 300 into manifold 700. Manifold valve 720 is opened permitting fuel to flow into manifold 701. (Since upper aux tank 400 and lower aux tank 500 are not involved in the fuel transfer pumps 401, 402, 501, 502 and fill valves 410, 510 are off and closed, respectively.) Pumps 601, 602, 603 are also off. Manifold valve 620 and fill valve 610 are opened, thereby permitting the fuel in manifold 701 to flow into tail tank 600. When the desired center of gravity is achieved, i.e., the desired amount of fuel has been transferred to tail tank 600, then the transfer process is halted. Manifold valve 620, 720, and fill valve 610 are closed. Then pumps 103, 303 are turned off. The system configuration is now in a quiescent state in which fuel is delivered to the engines 10-30 and no fuel transfers are taking place. It will be understood by those skilled in the art that control of the controlled components is by a processor (or controller) 50. The processor 50 of the preferred embodiment of the present invention is dedicated to the fuel distribution task, although, as will also be recognized by those skilled in the art, the processor need not be dedicated to the fuel distribution task.

Referring to FIG. 2, there is shown a functional flow diagram of the method of the present invention performed by a controller 50 of the distributed fuel system of FIG. 1. Based on data received from systems external to the distributed fuel system 1, aircraft and system status is determined (block 800). The input data received by the processor 50 includes aircraft inputs and fuel system inputs and includes such values as flight configuration (e.g., airspeed, altitude, landing gear position, . . .) fuel quantities, pump/valve position feedback, ... Based on the status information, an evaluation is made to determine which functions need to be accomplished by the controller 50 during the current processing cycle, and the functions are selected (block 805). The functions include:

a. Supplying fuel to engines requiring fuel,
b. Fuel transfers to maintain proper fuel distribution,
c. Fuel transfers to correct or adjust for failures within the fuel system,
d. Fuel transfers to control the aircraft center of gravity,
e. Fuel transfers to comply with the aircraft operating limitations, ...

Claims 1, 9 and 10

Claims 1, 9 and 10 on appeal read as follows:

1. A fuel transfer apparatus for an aircraft comprising:
at least two fuel tanks arranged in an inboard to outboard alignment,
at least one tank being situated in a wing of the aircraft,
at least one pump for transferring fuel between the tanks, and
a fuel management system for controlling and monitoring the transfer of fuel between tanks, said system comprising:
means for receiving a first input signal that the aircraft has left the ground;
means for receiving a second input signal that the aircraft is approaching its destination,
means for initiating the transfer of the fuel from a relatively inboard tank location to a relatively outboard tank location in response to the first input signal, and
means for initiating the transfer of the fuel from a relatively outboard tank location to a relatively inboard tank location in response to the second input signal.

9. A method of fuel transfer for an aircraft including at least two fuel tanks arranged in an inboard to outboard alignment with respect to a centerline of the aircraft, at least one outboard tank being situated in a wing of the aircraft, at least one pump for transferring fuel between the tanks, and a fuel management system for controlling and monitoring the transfer of fuel between tanks, said method comprising the steps of:

providing a first input signal, indicating that the aircraft has left the ground;

initiating the transfer of the fuel from a relatively inboard tank location to a relatively outboard tank location in response to the first input signal, [sic, ;]

providing a second input signal that the aircraft is approaching a destination; and

initiating the transfer of the fuel from said at least one outboard tank to said inboard tank in response to the second input signal.

10. A fuel transfer apparatus for an aircraft having at least one inboard fuel tank and at least one outboard fuel tank, said at least one outboard tank being situated in a wing of the aircraft, at least one pump for transferring fuel between the tanks, and a fuel management system for controlling and monitoring the transfer of fuel between tanks, said system comprising:

means for initiating the pump transfer of the fuel from said at least one inboard tank to said at least one outboard tank in response to a first input signal that the aircraft has left the ground; and

means for initiating the transfer of the fuel from said at least one outboard tank to said at least one inboard tank in response to a second input signal that said aircraft is approaching a destination.

In the rejection under 35 U.S.C. § 103 before us in this appeal, the examiner stated (answer, p. 8) that:

> It would have been obvious to one having ordinary skill in the art at the time the invention was made to make the fuel balancing system of Makhonine automatic with a processor and sensor input means as taught in general by Bell since it will provide for automatic control in place of human control. Such an obvious system would replace the pilot sensed situations of takeoff and landing with mechanical means such as landing gear sensing for takeoff and an approaching altitude or distance from ground (which is part of a preprogrammed

path) for approaching landing (which Bell states are well known inputs to an automatic fuel control for a fuel transfer to comply with aircraft operating limitations). The processor 50 of Bell being a computer operates on some algorithm. All this would be motivated as stated by Bell to take the human action out and be replaced by an automated system to provide predictably, reliably, and consistency.

Makhonine in col 2 second paragraph describes the steps set forth by applicant but without the automatic action and this has long been held to be an obvious modification. The pilot senses that the plane takes off and transfers the fuel and he senses when the plane is going to land (approaching the destination) and transfers the fuel and to provide some automatic means to do, this is merely the use of modern technology. In re Venner, 262 F.2d 91, 120 USPQ 193, 194 (CCPA 1958) (Appellant argued that claims to a permanent mold casting apparatus for molding trunk pistons were allowable over the prior art because the claimed invention combined "old permanent - mold structures together with a timer and solenoid which automatically actuates the known pressure valve system to release the inner core after a predetermined time has elapsed." The court held that broadly providing an automatic or mechanical means to replace a manual activity which accomplished the same result is not sufficient to distinguish over the prior art.).

The appellants argue throughout the briefs that there are three significant errors in the examiner's rejection. These three errors can be summarized as follows:

(1) There is no prior art teaching of a means for receiving the first or second input signals;

(2) There is no prior art teaching of any fuel transfer means which is responsive to either the first or second input signals; and

(3) The Examiner fails to provide any reason or motivation for combining the Makhonine and Bell references.

In our view, the combined teachings of Makhonine and Bell would have made it obvious at the time the invention was made to a person of ordinary skill in the art to have computerized and automated the fuel transfer system of Makhonine as suggested and taught by Bell so as to reduce aircraft operating costs as taught by Bell. Makhonine's above-quoted teaching at column 2, lines 8-15 provides at least inherent support that (1) a person (if not in fact an automated sensor) onboard the aircraft (e.g., the pilot, flight engineer, etc.) actuates some type of switch after the aircraft has left the ground which causes pumps j to initiate the transfer of fuel from the inboard tanks f to the outboard tanks g and (2) a person (if not in fact an automated sensor) onboard the aircraft (e.g., the pilot, flight engineer, etc.) actuates some type of switch before the aircraft lands which causes pumps k to initiate the transfer of fuel from the outboard tanks g to the inboard tanks f. Bell clearly teaches the benefits of replacing a manually actuated fuel transfer system with an automated computer control fuel transfer system. Accordingly, we find the appellants' argument that there is no motivation to combine Makhonine and Bell unavailing.

We also find the appellants' argument that the applied prior art does not suggest a means for receiving the first or second input signals or any fuel transfer means which is responsive to either the first or second input signals to be unavailing for the following reasons. As stated above, it is our determination that the combined teachings of

Makhonine and Bell would have made it obvious at the time the invention was made to a person of ordinary skill in the art to have computerized and automated the fuel transfer system of Makhonine as suggested and taught by Bell. The thus modified fuel transfer system of Makhonine would automatically detect both that the aircraft has taken off and that the aircraft is about to land (i.e., flight configuration data such as airspeed, altitude, landing gear position) and feed those signals to a computer. That structure would constitute means for receiving a first input signal that the aircraft has left the ground, and means for receiving a second input signal that the aircraft is approaching its destination. Additionally, the modified fuel transfer system of Makhonine would have the computer automatically control Makhonine's pumps j and k based upon the input signals. That structure would constitute means for initiating the transfer of the fuel from a relatively inboard tank location to a relatively outboard tank location in response to the first input signal, and means for initiating the transfer of the fuel from a relatively outboard tank location to a relatively inboard tank location in response to the second input signal.

For the reasons set forth above, the decision of the examiner to reject claims 1, 9 and 10 under 35 U.S.C. § 103 is affirmed.

Claims 2, 4 and 8

Claims 2, 4 and 8 read as follows:

2. A fuel transfer apparatus as claimed in claim 1 wherein the fuel management system is computerised and comprises a computer algorithm designed to respond to the various input signals and initiate the fuel transfer in the desired sequence.

4. A fuel transfer apparatus as claimed in claim 1 wherein the fuel management system is programmed to respond to a first signal sent to the flight control system of the aircraft when the gear wheels have left the ground.

8. An aircraft comprising a fuel transfer apparatus as claimed in claim 1.

As stated above, it is our view that the combined teachings of Makhonine and Bell would have made it obvious at the time the invention was made to a person of ordinary skill in the art to have computerized and automated the fuel transfer system of Makhonine as suggested and taught by Bell so as to reduce aircraft operating costs as taught by Bell.

As to claim 2, the teachings of Bell clearly would have made it obvious at the time the invention was made to a person having ordinary skill in the art to have modified the fuel transfer system of Makhonine to include a fuel management system which is computerized by utilizing a computer algorithm designed to respond to the various input signals and initiate the fuel transfer in the desired sequence.

As to claim 4, the teachings of Bell clearly would have made it obvious at the time the invention was made to a person having ordinary skill in the art to have modified Makhonine so as to generate the first input signal upon the gear wheels leaving the ground.

As to claim 8, Makhonine as modified by Bell would constitute an aircraft having a fuel transfer apparatus as claimed in claim 1.

For the reasons set forth above, the decision of the examiner to reject claims 2, 4 and 8 under 35 U.S.C. § 103 is affirmed.

Claims 3 and 5 to 7

Claims 3 and 5 to 7 read as follows:

3. A fuel transfer apparatus as claimed in claim 2 wherein the computer algorithm is specific to a pre-programmed flight path for the aircraft.

5. A fuel transfer apparatus as claimed in claim 1 wherein the fuel management system is programmed to respond to a second input signal that the aircraft has descended to a certain altitude on its approach to land.

6. A fuel transfer apparatus as claimed in claim 1 wherein said second input signal is relayed between the flight control program and the fuel management system when a certain point on a preprogrammed flight path has been reached.

7. A fuel transfer apparatus as claimed in claim 1 wherein the fuel management system will have manual override facility to enable flight crew to adapt to unforeseen circumstances.

For the reasons set forth in the brief, the limitations of claims 3 and 5 to 7 are not taught or suggested by the combined teachings of Makhonine and Bell. With regard to claim 5, while Bell teaches that the input data received by his processor 50 includes aircraft inputs such as flight configuration (e.g., airspeed, altitude, landing gear position), Bell does not teach or suggest programming the fuel management system to respond to an input signal that the aircraft has descended to a certain altitude *on its approach to landing*. Accordingly, the decision of the examiner to reject claims 3 and 5 to 7 is reversed.

CONCLUSION

To summarize, the decision of the examiner to reject claims 1 to 10 under 35 U.S.C. § 103 is affirmed with respect to claims 1, 2, 4 and 8 to 10 and reversed with respect to claims 3 and 5 to 7.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 37 CFR § § 1.136(a).

AFFIRMED-IN-PART

IRWIN CHARLES COHEN Administrative Patent Judge	
JEFFREY V. NASE Administrative Patent Judge	BOARD OF PATENT APPEALS AND INTERFERENCES
JENNIFER D. BAHR Administrative Patent Judge	

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